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Polarization switching effects in thin BZT films

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Thin ferroelectric films of barium zirconate titanate $Ba(Zr_{1-x}Ti_x)O_3$ (BZT) solid solutions are promising materials for microwave devices [1, 2]. These materials are of interest due to the fact that when Ti atoms are replaced by Zr atoms, microwave losses and leakage currents can be reduced [3]. In this paper, using the methods of contact scanning probe microscopy (SPM) and piezoelectric microscopy, the processes of local charging and repolarization of BZT films, as well as the storage times of the created domains were investigated.

We studied $Ba(Zr_{1-x}Ti_x)O_3$ 100 nm thick films (with x from 0.2 to 0.65), obtained by plasma deposition with a double system of crucibles. The main task of SPM research was to investigate the features of the structural and ferroelectric properties of these films. Also in this work, experiments were carried out to create ferroelectric domains, to establish the effect of annealing on the ferroelectric properties and to determine the lifetime of the domains.

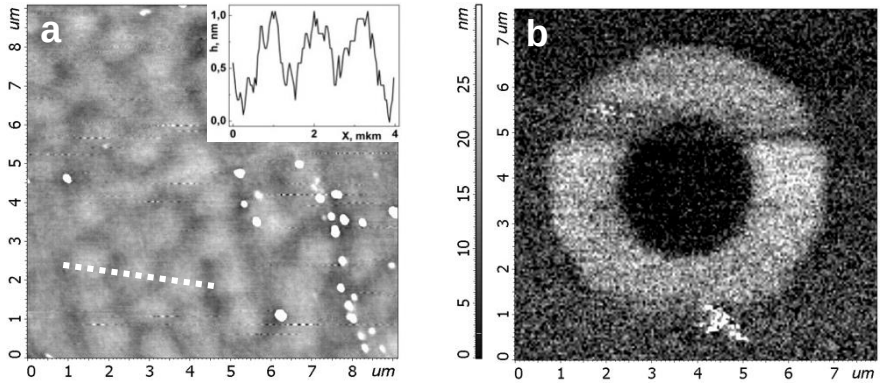

Figure 1. (a) Typical SPM topography of BZT film, inters – profile along dotted line; (b) PFM image of polarized BZT film: +10 V (“light” donut-shaped area), -10 V (“dark” round area in the center).

Figure 1a shows the typical topography of one of the studied BZT films. The inset shows the profile along the characteristic topographic features of the relief. It can be seen that the sample is quite smooth, the characteristic z-height of the relief is 1 nm, while the lateral size of the topographic features is about 1 micron. Figure 1b shows a PFM image obtained by scanning an area of BZT film with “–z polarized” (“dark” round area in the center of Fig.1b) and “+z polarized” (“light” donut-shaped area in the Fig.1b) regions. In the "light"/”dark” region, the polarization vector is directed outside/inside the film. Outside there is a region with intermediate polarization (between "+z" and "-z").

It has been established that the lifetime of the created domains is at least several hours. Also a local hysteresis loop of the BZT films has been measured with the SPM technique. It was established that thermal annealing of BZT films does not lead to the complete disappearance of the domains, but it reduces their lifetime and the average value of residual polarization.

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1. O.G. Vendik, *Phys. Solid State* **51**, 1529 (2009).
2. S. Gevorgian, *Ferroelectrics in microwave devices, circuits and systems* (Springer London), 396, (2009).
3. H. Chen., C. Yang, J. Zhang, B. Wang, H. Ji, *Appl. Surf. Sci.* **255,** 4585 (2009).